

SN 10/789,588
Docket No. S-100,636
In Response to Office Action dated 10/31/2006

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REMARKS

The Office Action has been carefully reviewed. Reconsideration and allowance of the claims in light of the foregoing amendments is respectfully requested. A petition and fee for a three-month extension of time is submitted herewith.

Claims 1, 4-7 and 9-12 were rejected under 35 U.S.C. 102(a) as being anticipated by Xi. In the paper Xi presents spectroscopic studies on conjugated polymers in mesoporous channels. The influence of mesoporous environment on the conjugated polymers was studied by UV-Vis absorption and Photoluminescence spectroscopy (detector). The applied polymers were three novel poly(p-phenylenevinylene) derivatives (DDMA-PPV) shown in figure 1. These polymers have dibenzothiophen-5,5-dioxide units in their backbones, but are different from each other in the length of alkoxy side-chains. The polymers were incorporated into the mesoporous channels of SBA-15 by sorption from their dilute solutions. The confined polymers exhibited different trends in the shifts of the absorption onsets and the emission peaks depending on the length of the side-chains. The polymer with shorter side-chain showed red-shifts in both the absorption and emission spectra, whereas the polymer with longer side-chain showed blue-shifts. These phenomena were caused by the combined influences from the electronic confinement and the conformation distortion. Moreover, these trends were enhanced when the polymers were loaded in amine-modified SBA-15. The synthesis of [sic - of] the mesoporous silica materials is taught in the experimental section and used an amphiphilic block copolymer under acidic conditions.

Applicants submit that Xi fails to anticipate the presently claimed invention in that Xi does not describe or teach a mesostructured inorganic thin film. Rather, while Xi describes mesoporous silica as a host material for conjugated polymers, there is no teaching or suggestion of "an inorganic thin film having a defined mesoporous structure" as in present claims 1, 4-7 and 9-12. Rather, Xi describe the preparation of their mesoporous silica (see 2.1 Preparation of host materials at page 2452, 1st column) in the manner used by Zhao et al. (J. Am. Chem. Soc., 1998, 120, 6024-6036) wherein the preparation technique yields bulk powders. Accordingly, claims 1, 4-7 and 9-12 are not anticipated by Xi. Further, Xi fails to describe or suggest "a sensor having a responsive

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element for a detectable species", a "responsive element including a nanocomposite structure of an inorganic thin film having a defined mesostructure and a conjugated polymer immobilized within said mesostructured inorganic thin film" and "a detector means for detecting a response of said responsive element upon exposure to said detectable species" as in claims 6-7 and 9-12. Accordingly, claims 6-7 and 9-12 are not anticipated by Xi.

Note that Xi prepare their conjugated polymer – mesoporous silica structure by incorporating the polymer into pre-made porous silica (see 2.3 Incorporation of polymers into mesoporous hosts at page 2452, 2nd column). In contrast, the applicants prepare their thin films by deposition of a mixture of silica precursor, surfactant and conjugated polymer onto a fused silica substrate (see example 1 at page 6 of the specification). As Xi

Claims 1-12 were rejected under 35 U.S.C. 103(a) as being unpatentable over Hernandez in view of Zhao. The Office Action stated that in the paper Hernandez teaches the controlled placement of luminescent polymers in mesostructured sol-gel thin films. Three 1-step methods to design hybrid mesoporous SiO₂ thin films in which the desired molecule is deliberately placed in a specified region of the mesostructure were demonstrated. These methods are improvements on methods that form the mesoporous structure first followed by diffusion of the dopant into empty pores. The 2nd approach utilizes an organic conducting polymer containing sulfonate groups (i.e., water-soluble poly((2,5-methoxypropyloxysulfonate)phenylene vinylene)), which is dissolved in the initial sol, and, as the film is formed, the organic backbone is incorporated in the organic region of the film while the sulfonate groups reside in the ionic interface region. In this process the polymer is added to a solution containing the sol gel forming precursors and the cationic template cetyltrimethylammonium bromide (CTAB, see footnote 31). Figure 2 and its associated discussion teach the detection of polarized fluorescence from the material. The Office Action noted that Hernandez does not teach the use of a non-cationic surfactant in the formation of the mesoporous structure.

In the paper Zhao teaches a family of highly ordered mesoporous (20-300 Å) silica structures synthesized by the use of commercially available nonionic alkyl poly(ethylene oxide) (PEO) oligomeric surfactants and poly(alkylene oxide) block

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copolymers in acid media. Periodic arrangements of mesoscopically ordered pores have been prepared. Under acidic conditions at room temperature, the nonionic oligomeric surfactants frequently form cubic or 3-d hexagonal mesoporous silica structures, while the nonionic triblock copolymers tend to form hexagonal (p6mm) mesoporous silica structures. Hexagonal mesoporous silica structures with d(100) spacings of 64-77 Å can be synthesized at 100 C by using oligomeric nonionic surfactants.

The Office Action concluded that it would have been obvious to one of ordinary skill in the art at the time the invention was made to use a non-ionic block copolymer in the Hernandez process of forming the mesoporous materials because of the advantages related to ability to tune the structure based on the surfactant structure, cost of the materials and the similarity to the process used in forming the structure using cationic surfactants in an acidic environment as taught by Zhao.

Applicants submit that while Hernandez describes the preparation of mesostructured sol-gel thin films using a cationic surfactant template (CTAB), Zhao describes the preparation of bulk powders of mesoporous silica. Claims 1-5 are directed to an inorganic thin film formed in a surfactant based formation process including a non-cationic surfactant template material. Nothing in Zhao's teaching of preparing bulk powders with non-ionic surfactant templates suggests combination with the Hernandez process for yielding mesostructured sol-gel thin films. Accordingly, applicants submit that claims 1-5 are not obvious over Hernandez in view of Zhao.

Further, applicants submit that neither Hernandez nor Zhao describe or suggest a sensor having a responsive element for a detectable species", a "responsive element including a nanocomposite structure of an inorganic thin film having a defined mesostructure and a conjugated polymer immobilized within said mesostructured inorganic thin film" and "a detector means for detecting a response of said responsive element upon exposure to said detectable species" as in claims 6-12. Accordingly, applicants submit that claims 6-12 are not obvious over Hernandez in view of Zhao.

Claims 13-17 were rejected under 35 U.S.C. 103(a) as being unpatentable over Hernandez in view of Zhao as applied to claim 1-12 above, and further in view of Chen. The Office Action noted that Hernandez does not teach the use of the materials to sense nitroaromatics.

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However, the office Action stated that in the paper Chen discusses the application of poly((2,5-methoxypropyloxysulfonate)phenylene vinylene) for chemical sensing. Both the photophysics and the fluorescence quenching behavior of the anionic conjugated polymer towards various small molecule quenchers can be modulated effectively by complexing the polymer with a simple counter-charged detergent. For example upon adding dodecyltrimethylammonium bromide (DTA) to the polymer, cationic quenchers such as Me viologen become less effective while the quenching by neutral reagents – most notably nitroaromatics into association with the polymer. Thus, the polymer-detergent complex provides a new platform for sensing chemical agents via fluorescence quenching. Thin films formed from the complex exhibit high sensitivity to quenching by nitroaromatic vapor (TNT and DNT, figures 3 and 5) and reasonable reversibility.

The Office Action concluded that it would have been obvious to one of ordinary skill in the art at the time the invention was made to use the Hernandez material as a sensing material for nitroaromatics because of the use of the polymer in the presence of a surfactant as taught by Chen.

Applicants submit that nothing in Hernandez, Zhao or Chen would suggest that the conjugated polymer of the claimed “sensor including a responsive element for said detectable nitro-containing organic species, said responsive element including a nanocomposite structure of an inorganic thin film having a defined mesostructure and a conjugated polymer immobilized within said mesostructured inorganic thin film, said sensor element adapted for a chemical interaction of a nitro-containing organic species” (see claims 13-17) would be accessible to the nitroaromatic as the nitroaromatic must diffuse through the silica framework to the polymer. Additionally, nothing in Hernandez, Zhao or Chen would suggest that in such a claimed detection method, the responsive element is essentially fully reversible (see claim 16). Accordingly, applicants submit that claims 13-17 are not obvious over Hernandez in view of Zhao and Chen.

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In view of the foregoing remarks, claims 1 -17 are urged to be allowable over 35 U.S.C. 102 and 103. If the Examiner believes there are any unresolved issues despite this amendment, the Examiner is urged to contact the applicants' attorney undersigned below for a telephonic interview to resolve any such issue. A favorable action is solicited.

Respectfully submitted,

Date: April 30, 2007

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